~~TITLE OF THE INVENTION~~

~~Can Manufacture~~

~~BACKGROUND OF THE INVENTION~~

~~[0001] This invention relates to can manufacture and, in particular, to the production of thin-walled metal cans by the so-called "drawing and wall-ironing" (DWI) process.~~

~~[0002] In a DWI process, a flat circular blank of metal is drawn through one or more drawing dies to form a shallow cup. The cup is then mounted on the free end of a punch which extends from a reciprocating ram, and the cup wall is then "ironed" by passing through one or more ironing dies to lengthen the side wall of the cup and form a can.~~

~~[0003] The ironing process produces elongation of the side wall by very high radial compression of the wall of the cup as the cup is pushed through the ironing dies and is ironed by die inserts (sometimes referred to as the die "nibs").~~

~~[0004] Friction resulting from the ironing process generates heat in the punch and ironing dies. Furthermore, misalignment of the punch with the die assembly or "toolpack" may result in uneven distribution of temperature around the punch and die inserts. One technique which has been used to accommodate deflection of the punch from its central position is to use so-called "floating" dies which are supported by rubber O-rings or coil springs in the dies which impart resilience to the dies and allow these to move radially with respect to the axis of the punch.~~

~~[0005] One proposal to reduce the temperature of the die insert is disclosed in WO 03/039780 (Sequa Machinery, Inc.) in which a toolpack includes ironing dies which have conduits for channelling cooling fluid between an outer surface of the die insert and the die case. This toolpack differs from many conventional toolpacks in that the coolant fluid is not applied to the exterior of the toolpack where the cooling fluid may risk contamination of the container surface, necessitating cleaning of the cans after forming. This is a particular problem if the can material has a coating which could be attacked or damaged by coolant.~~

~~[0006] Nonetheless, although no extra washing is required with the Sequa system, it does exhibit a number of other drawbacks. Firstly, although the Sequa toolpack is a floating system, the dies are fixed together and cannot be removed radially to allow for individual maintenance of die modules. Secondly, there are several O-rings used in each die of this system which act as seals and care is needed to replace these correctly without poor seating. Finally, the die inserts ("nibs" in the Sequa disclosure) are subjected to large forces during the ironing operation but because the coolant is channelled close to the surface of the carbide die insert, this renders the inserts too fragile for high speed production of DWI cans.~~

~~SUMMARY OF THE INVENTION~~

~~[0007] According to the present invention, there is provided an apparatus for the production of a metal~~

~~container, the apparatus comprising: at least one die having an insert adapted to reduce the thickness of the container side wall by ironing, at least one coolant die adjacent the ironing die(s) and having an internal cooling cavity for circulating coolant within the coolant die and adjacent the ironing insert of the ironing die.~~

~~[0008] By using a coolant die rather than introducing channels into the ironing die itself, coolant is directed close to the ironing insert, as in known systems, but without weakening the die insert. The ironing die insert may also be reduced in width since the cooling action is achieved using an independent cooling die or dies. The die insert is typically of carbide since the thermal conductivity of carbide is approximately twice that of the steel from which the rest of the ironing die is made. This carbide insert may be extended, i.e. made larger in diameter, in the present apparatus so as to increase the contact area with the adjacent cooling cavity, and thereby extract heat faster. Any number of coolant dies may be used, depending on the desired progression length and range of heights of cans for manufacture.~~

~~[0009] Usually the cooling cavity has an inlet and an outlet, the outlet including a restrictor. Using a restrictor at the outlet creates back pressure to ensure that the cooling cavity stays full of coolant, thereby presenting the maximum possible cooling surface to the adjacent die insert and avoiding dry spots which would allow heat build up.~~

~~[0010] The coolant die may include a vacuum port for removal of debris. The coolant die at the exit of the apparatus (i.e. where the punch exits the toolpack) may include an array of air jets arranged around its inner surface to prevent any debris from settling on the surface of the can.~~

~~[0011] Preferably the cooling cavity includes a portion which is inclined towards the adjacent die insert to form a cooling face. Generally a coolant die is provided on each side of an ironing die so that the die insert of the ironing die has heat extracted from both sides by adjacent coolant dies. By angling the cooling cavities towards the ironing die inserts, the working portion of the coolant cavities (lands) are as close as possible to the centre of the die insert.~~

~~[0012] In a preferred embodiment, the apparatus further comprises a system for biasing the cooling face against the ironing die. For example, the cooling face may be formed from an annular piston which is resiliently mounted on the body of the coolant die, the biasing system for activating the piston being provided by cooling fluid pressure. This cooling fluid pressure may be provided by the back pressure deriving from use of a restrictor at the outlet to the cooling cavity.~~

~~[0013] Floating dies have to have axial clearance in order to move ("float") and consequently they can vibrate. An additional benefit of the biasing system is that it acts~~

~~as a damper to reduce ring vibration which can cause radial ring marks on the surface of a can in a floating toolpack. The piston keeps the cooling face in full contact with the die at all times whilst still allowing the die to float. This clamping could alternatively be achieved by coil springs, disc springs, O-rings, rubber springs, polyurethane etc.~~

~~[0014] Generally, the apparatus also comprises a ram having a cooling tube assembly at one end and a punch at the other end, the punch being connected to the ram by a ram spigot, a cooling fluid inlet formed partly between inner and outer concentric tubes of the cooling tube assembly and partly between an axial extension of the inner tube of the cooling tube and the inside of the ram spigot, a cavity adjacent the punch nose which is connected to the cooling fluid inlet by one or more holes, the cavity being further connected to a cooling fluid outlet by one or more holes, the cooling fluid outlet being formed (a) between the punch and the outside of the ram spigot, (b) by one or more holes in the body of the ram and (c) between the outer tube of the cooling tube assembly and the inside of the ram.~~

~~[0015] The apparatus may also include a tubular assembly for guiding the ram along its bore, the assembly having a fluid inlet, a fluid outlet and grooves around the surface of the bore for passage of cooling fluid around the outside of the ram. This guidance assembly thus also cools the punch/ram externally to help dissipate heat from the punch.~~

~~This also maintains the ram at an even temperature and prevents ram distortion from uneven heat build up.~~

~~[0016] The ram guidance assembly may employ a seal arrangement at both ends to prevent the cooling fluid from leaking into the machine at the rear and leaking into the tooling at the front.~~

~~BRIEF DESCRIPTION OF THE DRAWINGS~~

~~[0017] Preferred embodiments of the invention will now be described, by way of example, with reference to the drawings, in which:~~

~~Figure 1 is a side sectional view of a first embodiment of die toolpack;~~

~~Figure 2 is a side sectional view of a second embodiment of die toolpack.~~

~~Figures 3 to 7 are side sectional views of a ram coolant system;~~

~~Figure 8 is a side sectional view of a coolant tube assembly;~~

~~Figure 9 is an enlarged side sectional view of the ram of figure 3; and~~

~~Figure 10 is a side sectional view of ram guidance assembly.~~

~~DESCRIPTION OF THE PREFERRED EMBODIMENTS~~

~~[0018] Figure 1 is a side section of the die toolpack assembly of the invention comprising a series of ironing dies 1, 2, and spacers 3,4 and 5,6 and surrounding a central bore 7. Friction due to the ironing process~~

~~generates heat in the working portion of the ironing die. In contrast with known cooling systems, this heat is extracted from the ironing dies on both sides by the spacers rather than cooling via fragile inserts on the dies themselves. As a result of this, the ironing dies can be readily removed or changed without removal of screws or risk of coolant fluid spillage. Furthermore, the toolpack of the invention is cooled without allowing coolant into the bore of the machine through which the punch passes during ironing. This is particularly important if the material of which the can is made or of which it is coated might be attacked by such coolant.~~

~~[0019] Each spacer includes a coolant cavity 8 which is fed coolant from a single fixed inlet 9 on one side of the spacer. The cavity may be formed, for example, by grooves in inner and outer die spacers which form a channel when the parts are clamped together.~~

~~[0020] The water circulates round the spacer and exits on the opposite side 10 through a restrictor 11 to a common sump to be returned to the cooling unit. The use of restrictors at the outlet ports 10 creates a backpressure to ensure that the cooling cavity stays full and maintains an optimum cooling surface around the die. Furthermore, by regulating flow with flow restrictors on the exhaust side, flow can be tuned around each die independently. This means that dies can be cooled by different amounts and to different temperatures according to the work done by the die, such as degree of ironing. By exhausting coolant to a~~

~~tank, no coolant contacts the can. This is particularly useful if the coating on the can could be attacked or damaged by coolant and otherwise require an acid/alkaline rinse.~~

~~[0021] Each ironing die 1,2 includes a carbide insert 12 with the working portion 13 close to the centre of the insert. This carbide insert is contacted by coolant spacers, typically of tooled steel, on both sides. The coolant channels in the spacers are each angled towards the carbide insert 12 of the ironing die so that the optimum cooling surface area is provided.~~

~~[0022] A vacuum system 14 pulls away dust or debris from the can surface. If such debris were allowed to build up internally, it would cause surface scratching in the ironing process, particularly when the can has a coating such as a polymer coating. Air jets 15 or a knife system may be incorporated into any or all of the spacers, here shown in the end spacer 6, to prevent debris collecting around the end die. A further air jet/knife may be used to prevent debris collecting in the stripper area (not shown).~~

~~[0023] By using a fixed toolpack rather than floating, the use of seals is not required in the embodiment of figure 1. When such seals need to be changed due to damage or leakage, they must be replaced with care to avoid poor seating.~~

~~[0024] An alternative die toolpack assembly according to the invention is shown in figure 2. The toolpack of figure 2 is a floating toolpack system which uses O-rings 16 to allow compliance. In this toolpack, back pressure created by the restrictors 11 is used to operate a cylinder 17 which ensures that the cooling surface 18 stays in contact with the dies. The cylinder 17, which is in the rear face of the spacer, forms a piston. Floating dies inherently have to have axial clearance in order to move which can lead to vibration and result in ring marks around the can. The piston doubles as a damper to reduce the vibration which causes these ring marks. Such die vibration is common in floating systems.~~

~~[0025] The piston is activated by the cooling fluid pressure which keeps the cooling face in contact with the die at all times whilst still allowing the die to float. This clamping could also be applied by a spring system, which could be coil springs, disc spring, 'O' ring, rubber spring, polyurethane etc.~~

~~[0026] When a can is wall ironed, it is carried by a punch in which heat is also generated due to the friction involved in the process. Cooling of the punch/ram is therefore also of great importance, particularly if the can has a coating which can be damaged by heat, such as a plastic coating or tin coated steel. A ram coolant system for use with the die toolpack of figure 1 is shown in figures 3 to 9. In the system of the present invention, the whole ram assembly is cooled along its length, down to and~~

~~including the punch nose 21.The cooling fluid is in contact with the back of the punch nose 21, the internal diameter of the punch and any spacers 23.~~

~~[0027] With particular reference to figures 8 and 9, the ram is fitted with a coolant tube assembly 30. The coolant tube assembly 30 comprises inner and outer concentric tubes 31, 32 which are fastened together at connection points 33, 34. Galleries at the connection points allow for the flow of coolant such as cooling water, and air.~~

~~[0028] With reference to figures 6 and 7, the ram 20 is connected to a yoke slide 41, a seal 36 on that end of the coolant tube assembly 30 sealing air, incoming water and outgoing water supplies. Air passes down the centre tube 37 to assist stripping of the can from the punch 50. A seal assembly on the connection point 35 at the punch end of the cooling water tube assembly separates the cooling water and air strip. Alternatively a seal could be incorporated into the punch nose.~~

~~[0029] Cooling water is fed in through a manifold 40 mounted on the yoke slide 41, not directly to the ram (see figure 7). The coolant passes down the cooling water tube assembly 30, between the inner and outer tubes 31, 32. From there, coolant flows into the tubular cavity 24, between the inner tube 31 and the inside of a ram spigot 25. As shown in figure 9, the coolant then flows past the punch retainer through holes 22 and into cavity 26.~~

~~[0030] Coolant then returns back between the outside of the ram spigot 25 and the inside of the punch 50 along slots 27. It passes back into the main body of the ram through holes 28 and travels back between the outer tube 32 of the cooling water tube assembly and the inside of the ram to the manifold 40 on the yoke slide 41.~~

~~[0031] It should be noted that the terms "holes, "cavities" and "grooves" used above are used with reference to the drawings and for the purposes of differentiation only rather than being intended as being limiting in any way.~~

~~[0032] By use of a single cooling water tube assembly and channels cut in the outside diameter of the ram spigot 25 on which the punch 50 is mounted, there is no requirement for a cavity on the inside of the punch to connect the inlet and outlet ports. Further cooling is aided by reducing the central portion or portions of the ram spigot to create a large chamber for the fluid to contact the inner surface of the punch. Integrity of the ram spigot is improved in the assembly of the present invention as radially drilled holes used in prior art systems are avoided. These create stress raisers and can cause premature failure of the ram if a crack in the ram surface runs radially from one hole to the next.~~

~~[0033] As well as cooling the punch/ram internally, the ram is also cooled externally by the ram guidance assembly 60 of figure 10. This assembly helps to dissipate heat from~~

~~the punch and maintain the ram at an even temperature. If uneven heat builds up on the ram, this can lead to distortion of the ram. The ram guidance assembly 60 prevents such temperature differences from arising.~~

~~[0034] The assembly 60 has a seal arrangement 61 at both ends to prevent cooling fluid from leaking into the machine at the rear and leaking into the tooling at the front. The fluid is fed in under pressure at the position 62 as indicated by the arrow. It then passes along two bushes and round spiral grooves 63 in both directions, lubricating and cooling the ram 20. The coolant exits into cavities 64 between bushes and the seal packs 61. It then exits the ram guidance assembly via slots and holes in the housing and out through a check valve 65 back to the machine collection sump where it is returned to a chiller unit. The check valve 65 ensures that the assembly stays full of fluid and that there is complete coverage of the ram.~~

~~[0035] When the ram is fully back, the end of the punch fitted to the ram is level with the end of the front seal pack at position 66 on the drawing.~~

TITLE OF THE INVENTION

CONTAINER

BACKGROUND OF THE INVENTION

[0001] This invention relates to a metal container of the type having a body which is closed at one end by a peelable membrane or foil. In particular, it relates to a can body having a separate member fixed to one end and to which the peelable component is adhered.

[0002] The usage of the sheet metal from which a container is manufactured is obviously of economic importance to the industry. For example, when the sheet metal is "blanked" to form ring-shaped components to which a peelable component is applied, the material punched out of the middle is often discarded. Systems which reuse this blanked material in forming smaller sanitary (non-processed) can ends have been implemented but are inherently limited in the maximum size of ends which can be produced. The size of the sanitary ends is also such that they cannot be used on the same container as the ring without the resultant container being "top-heavy" and unstable. If the containers used for the ring and end are manufactured in different volumes then there will still be surplus of one of these and the manufacturing and mechanical handling logistics become difficult.

[0003] This invention seeks to provide a stable container which minimises metal usage and is readily handled during manufacture, filling and on shop shelves.

SUMMARY OF THE INVENTION

[0004] According to the present invention, there is provided a metal container comprising a base, a side wall and a ring component which is adapted to be closed by a peelable membrane or foil, the base and the ring component being formed from the same sheet metal, in which the container side wall is flared outwardly at the end to which the ring component is fixed by between 6 mm and X mm, where X = 0.15 times the diameter of the container side wall, has a central section of substantially constant cross-section, and is tapered inwardly at the base by between 2 mm and Y mm, where Y = 0.22 times the diameter of the side wall.

[0005] Typical examples of X and Y are therefore X = 11 mm and Y = 16 mm for a 73 mm can side wall diameter, although different can bodies diameters may also be used. Although a side wall diameter of 150 mm is currently the largest which is likely to be used with this invention, the invention is clearly not limited in this respect.

[0006] The preferred range of flare and/or taper angle is 20° to 50° so as to minimise the length of material to be formed without compromising axial strength.

[0007] The maximum amount of flare for the upper end of the container is selected as that which provides ease of filling without risking handling difficulties on the manufacturing line or supermarket shelves. The maximum taper at the bottom end is that which is possible without

risk of instability of the container. However, a minimum amount of flare/taper is required if the ring component and base are to be manufactured from the same sheet metal.

[0008] In a typical cylindrical container to hold between 80g and 500g of food the difference between upper diameter D_2 and the side wall diameter D_1 is from 6 mm to 12 mm and the difference between the end diameter D_3 and the upper diameter D_2 is from 14 mm to 28 mm. Preferably, the difference $D_2 - D_1$ is between 10 mm and 11 mm and the difference $D_2 - D_3$ is between 23 mm and 27 mm.

[0009] The ring component may generally include a flat panel to which a peelable membrane is fixable, the flat panel preferably having a seal portion with a width of 2 to 6 mm. The cut edge of the ring portion may be curled either outwardly or inwardly so as to hide the cut edge.

[0010] For optimum product release, particularly when the product is solid, such as pet food, the internal diameter of the ring component for a cylindrical container may be the same as or greater than the diameter D_1 of the side wall.

[0011] For such products which need to be easily removed, the diameter D_3 is ideally at least 15 mm smaller than the side wall diameter D_1 since this enables a ring component to be manufactured from the same material as the base, but having an internal ring diameter which is greater than or equal to the side wall diameter.

[0012] According to a further aspect of the present invention, there is provided a method of forming a container comprising: forming a cylindrical side wall; expanding the side wall at one end and necking the side wall at the opposite end; forming an intermediate component having a seaming panel connected by a wall to a flat annulus, a substantially cylindrical wall portion and a centre panel; cutting the centre panel out of the intermediate component and curling the cylindrical wall to form a ring component; seaming the ring component to the expanded end of the side wall and the centre panel to the necked end.

[0013] The step of forming the intermediate component may comprise forming can end features on the centre panel.

BRIEF DESCRIPTION OF THE DRAWING

[0014] A preferred embodiment of the invention will now be described, by way of example only, with reference to the drawing which is a schematic side view of one progression of forming a ring component and can end for seaming to the same can body.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] Figure 1 shows a ring 1 for closing by a peelable foil or membrane 2, a can body 3 and sanitary end 4. With reference to figure 1(a) to 1(c), ring 1 and end 4 are formed from the same sheet metal 5 by drawing the metal

sheet into a shallow cup 6 with flat annular portion 7 and wall 8 extending into a seaming panel 9 and terminating in curl 10. Base 11 of the cup 6 is severed close to the cup wall 12 so as to form a stepped disc 13 which is subsequently to be used for forming the base of the container. The wall 12 is then curled adjacent annulus 7, thus forming a bond surface for fixing foil 2. In the figure 1(c) this bonding surface 7 is shown as flat but it may be inclined if desired for pressure performance purposes, for example. In one embodiment, a tab 14 may be formed from the foil 2.

[0016] As shown in figure 1(d), the can body 3 is formed from a cylinder of metal 15 which is expanded outwardly at one end 16 and necked inwardly at the opposite end 17. The body is provided with a flange 18, 19 at each end suitable for seaming the ring component 1 and can end 4 respectively.

[0017] Stepped disc 13, which was cut from the cup 6 (see figure 1(a) and 1(b)) is shallow drawn, curled and then seamed to the lower end of can body 3.

[0018] In accordance with the invention, the dimensions of the features are selected so as to enable the ring 1 and end 4 to be manufactured from a single sheet of metal. In particular, dimensions are selected as defined in the claims. One container made in accordance with the invention has a 200 ml contained volume and has an 83 mm diameter peel seam ring, 73 mm body diameter and 58 mm diameter end.

Another container had a 73 mm diameter ring, 65 mm diameter body and 51 mm diameter end.

[0019] The example of the figure may be modified by forming the steps in a series of simple forming operations or by carrying out one or more of the steps in a single machine. Furthermore, different shapes of formed components may be made so as to allow, say, the lower side of the sheet metal 5 to become the upper side of the ring 1 whilst remaining the lower side of end 4. This is particularly useful where the coating on one side is a "soft" material selected for bonding the peelable foil to the ring, but a more robust material is preferred for the end which is in contact with the product.

ABSTRACT OF THE DISCLOSURE

~~An assembly for can manufacture includes a toolpack having coolant dies (3,4,5,6) adjacent and either side of ironing dies (1,2) so that coolant may be circulated around cavities in the coolant dies so as to cool the ironing die inserts (12). Generally, the toolpack is used in conjunction with a ram (20), coolant tube assembly (30) and ram guidance assembly (60) which together ensure that the ram is cooled along its entire length, up to and including the punch nose (21).~~

An assembly for can manufacture includes a toolpack having coolant dies (3,4,5,6) adjacent and either side of ironing dies (1,2) so that coolant may be circulated around cavities in the coolant dies so as to cool the ironing die inserts (12). Generally, the toolpack is used in conjunction with a ram (20), coolant tube assembly (30) and ram guidance assembly (60) which together ensure that the ram is cooled along its entire length, up to and including the punch nose (21).